NI 5421 Specifications

NI PXI/PCI-5421 16-Bit 100 MS/s Arbitrary Waveform Generator

Unless otherwise noted, the following conditions were used for each specification:

- Analog Filter enabled.
- Interpolation set to maximum allowed factor for a given sample rate.
- Signals terminated with 50 Ω.
- Direct Path set to 1 V_{pk-pk}, Low-Gain Amplifier Path set to 2 V_{pk-pk}, and High-Gain Amplifier Path set to 12 V_{pk-pk}.
- Sample clock set to 100 MS/s.

Typical values are representative of an average unit operating at room temperature. Specifications are subject to change without notice. For the most recent NI 5421 specifications, visit `ni.com/manuals`.

To access all the NI 5421 documentation, including the *NI Signal Generators Getting Started Guide*, which contains functional descriptions of the NI 5421 signals, navigate to **Start»Programs»National Instruments»NI-FGEN»Documentation**.

Hot Surface If the NI 5421 has been in use, it may exceed safe handling temperatures and cause burns. Allow the NI 5421 to cool before removing it from the chassis.

Contents

NATIONAL INSTRUMENTS

CH 0
(Channel 0 Analog Output, Front Panel Connector)

Table 1.

Specification	Value	Comments
Number of Channels	1	—
Connector	SMB (jack)	—
Output Voltage Characteristics		
Output Paths	1. The software-selectable Main Output Path setting provides full-scale voltages from 12.00 V_{pk-pk} to 5.64 mV_{pk-pk} into a 50 Ω load. NI-FGEN uses either the Low-Gain Amplifier or the High-Gain Amplifier when the Main Output Path is selected, depending on the Gain attribute. 2. The software-selectable Direct Path is optimized for IF applications and provides full-scale voltages from 1.000 V_{pk-pk} to 0.707 V_{pk-pk}.	—
DAC Resolution	16 bits	—

Table 1. (Continued)

Specification	Value				Comments
Amplitude and Offset					
Amplitude Range	Path	Load	Amplitude (V_{pk-pk})		1. Amplitude values assume the full scale of the DAC is utilized. If an amplitude smaller than the minimum value is desired, then waveforms less than full scale of the DAC can be used. 2. NI-FGEN compensates for user-specified resistive loads.
			Minimum Value	Maximum Value	
	Direct	50 Ω	0.707	1.00	
		1 kΩ	1.35	1.91	
		Open	1.41	2.00	
	Low-Gain Amplifier	50 Ω	0.00564	2.00	
		1 kΩ	0.0107	3.81	
		Open	0.0113	4.00	
	High-Gain Amplifier	50 Ω	0.0338	12.0	
		1 kΩ	0.0644	22.9	
		Open	0.0676	24.0	
Amplitude Resolution	3 digits				—
Offset Range	Span of ±25% of Amplitude Range with increments <0.0014% of Amplitude Range.				Not available on the Direct Path.

Table 1. (Continued)

Specification	Value			Comments
Maximum Output Voltage				
Maximum Output Voltage	Path	Load	Maximum Output Voltage (V_{pk-pk})	The Maximum Output Voltage of the NI 5421 is determined by the Amplitude Range and the Offset Range.
	Direct	50 Ω	±0.500	
		1 kΩ	±0.953	
		Open	±1.000	
	Low-Gain Amplifier	50 Ω	±1.000	
		1 kΩ	±1.905	
		Open	±2.000	
	High-Gain Amplifier	50 Ω	±6.000	
		1 kΩ	±11.43	
		Open	±12.00	
Accuracy				
DC Accuracy	For the Low-Gain or High-Gain Amplifier Path: ±0.2% of Amplitude ± 0.05% of Offset ±500 µV (within ±10 °C of self-calibration temperature) ±0.4% of Amplitude ± 0.05% of Offset ±1 mV (0 °C to 55 °C)			All paths are calibrated for amplitude and gain errors. The Low-Gain and High-Gain Amplifier Paths also are calibrated for offset errors. Specifications valid only for high impedance.
	For the Direct Path: Gain Accuracy: ±0.2% (within ±10 °C of self-calibration temperature) Gain Accuracy: ±0.4% (0 °C to 55 °C) DC Offset Error: ±30 mV (0 °C to 55 °C)			
AC Amplitude Accuracy	±1.0% of Amplitude ±1 mV			50 kHz sine wave.
Output Characteristics				
Output Impedance	50 Ω nominal or 75 Ω nominal, software-selectable.			—
Load Impedance Compensation	Output amplitude is compensated for user-specified load impedances.			—

Table 1. (Continued)

Specification	Value			Comments
Output Coupling	DC			—
Output Enable	Software-selectable. When disabled, CH 0 out is terminated with a 1 W resistor with a value equal to the selected output impedance.			—
Maximum Output Overload	The CH 0 output can be connected to a 50 Ω, ±12 V (±8 V for the Direct Path) source without sustaining any damage. No damage occurs if the CH 0 output is shorted to ground indefinitely.			—
Waveform Summing	The CH 0 output supports waveform summing among similar paths—specifically, the outputs of multiple NI 5421 signal generators can be connected together.			—
Frequency and Transient Response				
Bandwidth	43 MHz			Measured at –3 dB.
Digital Interpolation Filter	Software-selectable Finite Impulse Response (FIR) filter. Available interpolation factors are 2, 4, or 8.			—
Analog Filter	Software-selectable 7-pole elliptical filter.			Available on Low-Gain Amplifier and High-Gain Amplifier Paths.
Passband Flatness	Path			—
	Direct	Low-Gain Amplifiers	High-Gain Amplifiers	
	+0.6 dB to –0.4 dB 100 Hz to 40 MHz	+0.5 dB to –1.0 dB 100 Hz to 20 MHz	+0.5 dB to –1.2 dB 100 Hz to 20 MHz	
Pulse Response	Path			Analog Filter and Digital Interpolation Filter disabled.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
Rise/Fall Time	<5 ns	<8 ns	<10 ns	
Aberration	<10%	<5%	<5%	

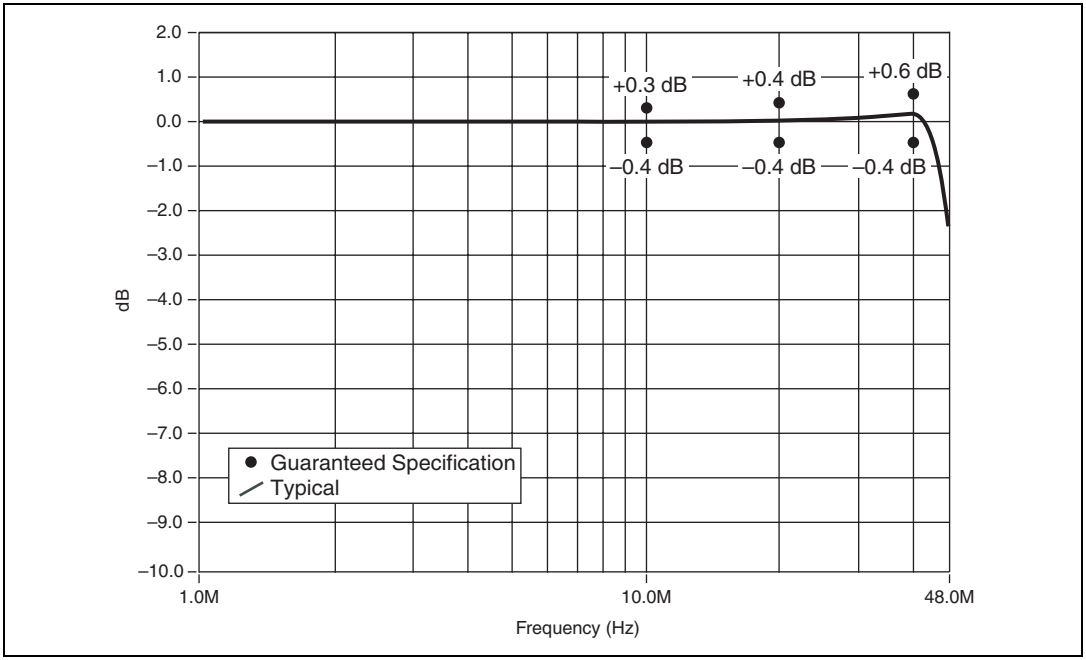

Figure 1. Normalized Passband Flatness, Direct Path

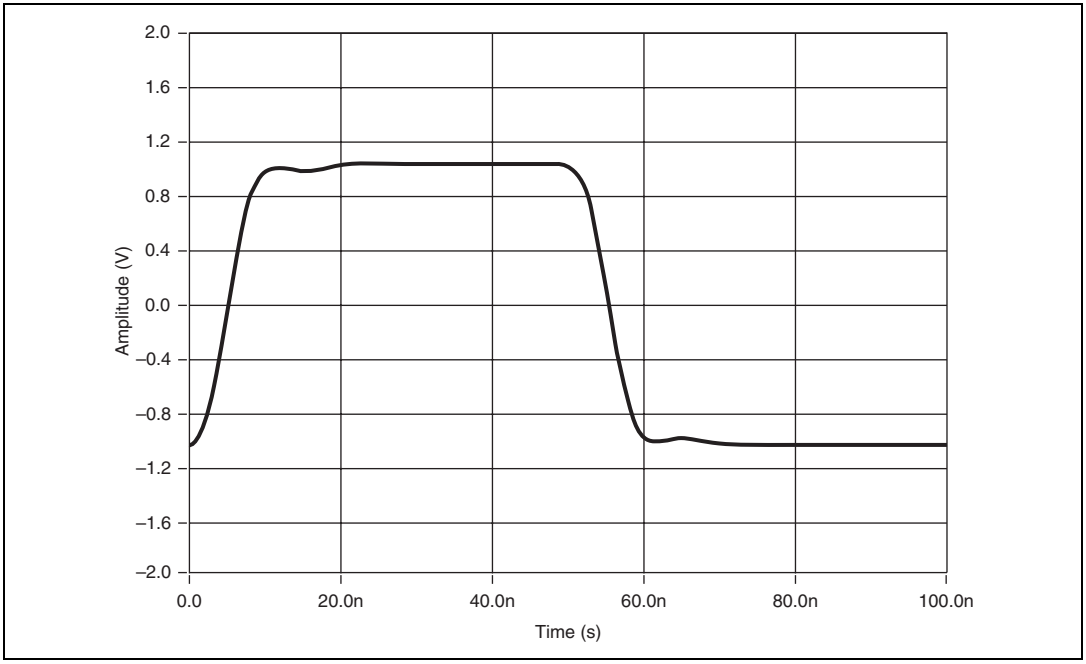

Figure 2. Pulse Response, Low-Gain Amplifier Path 50 Ω Load

Table 1. (Continued)

Specification	Value			Comments
Suggested Maximum Frequencies for Common Functions				
Function	Path			Disable the Analog Filter and the Digital Interpolation Filter for Square, Ramp, and Triangle.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
Sine	43 MHz	43 MHz	43 MHz	
Square	Not Recommended	25 MHz	12.5 MHz	
Ramp	Not Recommended	5 MHz	5 MHz	
Triangle	Not Recommended	5 MHz	5 MHz	
Spectral Characteristics				
Signal to Noise and Distortion (SINAD)	Path			Amplitude –1 dBFS. Measured from DC to 50 MHz. SINAD at low amplitudes is limited by a –148 dBm/Hz noise floor.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
1 MHz	64 dB	66 dB	63 dB	
10 MHz	61 dB	60 dB	47 dB	
20 MHz	57 dB	56 dB	42 dB	
30 MHz	60 dB	62 dB	62 dB	
40 MHz	60 dB	62 dB	62 dB	
43 MHz	58 dB	60 dB	55 dB	

Table 1. (Continued)

Specification	Value			Comments
Spectral Characteristics (Continued)				
Spurious-Free Dynamic Range (SFDR) with Harmonics	Path			Amplitude –1 dBFS. Measured from DC to 50 MHz. Also called harmonic distortion. SFDR with harmonics at low amplitudes is limited by a –148 dBm/Hz noise floor. All values are typical and include aliased harmonics.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
1 MHz	–76 dBc	–71 dBc	–58 dBc	
10 MHz	–68 dBc	–64 dBc	–47 dBc	
20 MHz	–60 dBc	–57 dBc	–42 dBc	
30 MHz	–73 dBc	–73 dBc	–74 dBc	
40 MHz	–76 dBc	–73 dBc	–74 dBc	
43 MHz	–78 dBc	–75 dBc	–59 dBc	
Spurious-Free Dynamic Range (SFDR) without Harmonics	Path			Amplitude –1 dBFS. Measured from DC to 50 MHz. SFDR without harmonics at low amplitudes is limited by a –148 dBm/Hz noise floor. All values are typical and include aliased harmonics.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
1 MHz	–88 dBFS	–91 dBFS	–91 dBFS	
10 MHz	–87 dBFS	–89 dBFS	–91 dBFS	
20 MHz	–80 dBFS	–89 dBFS	–89 dBFS	
30 MHz	–73 dBFS	–73 dBFS	–74 dBFS	
40 MHz	–76 dBFS	–73 dBFS	–74 dBFS	
43 MHz	–78 dBFS	–75 dBFS	–60 dBFS	

Table 1. (Continued)

Specification	Value			Comments
Spectral Characteristics (Continued)				
0 °C to 40 °C Total Harmonic Distortion (THD)	Path			Amplitude –1 dBFS. Includes the 2nd through the 6th harmonic.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
20 kHz	–77 dBc (typical)	–77 dBc (typical)	–77 dBc (typical)	
1 MHz	–75 dBc (typical)	–70 dBc (typical)	–62 dBc (typical)	
5 MHz	–68 dBc	–68 dBc	–55 dBc	
10 MHz	–65 dBc	–61 dBc	–46 dBc	
20 MHz	–55 dBc	–53 dBc	—	
30 MHz	–50 dBc	–48 dBc	—	
40 MHz	–48 dBc	–46 dBc	—	
43 MHz	–47 dBc	–45 dBc	—	
0 °C to 55 °C Total Harmonic Distortion (THD)	Path			Amplitude –1 dBFS. Includes the 2nd through the 6th harmonic.
	Direct	Low-Gain Amplifier	High-Gain Amplifier	
20 kHz	–76 dBc (typical)	–76 dBc (typical)	–76 dBc (typical)	
1 MHz	–74 dBc (typical)	–69 dBc (typical)	–61 dBc (typical)	
5 MHz	–67 dBc	–67 dBc	–54 dBc	
10 MHz	–63 dBc	–60 dBc	–45 dBc	
20 MHz	–54 dBc	–52 dBc	—	
30 MHz	–48 dBc	–46 dBc	—	
40 MHz	–46 dBc	–41 dBc	—	
43 MHz	–45 dBc	–41 dBc	—	

Table 1. (Continued)

Specification	Value						Comments
Average Noise Density		Amplitude Range		Average Noise Density			Average Noise Density at small amplitudes is limited by a –148 dBm/Hz noise floor.
	Path	V_{pk-pk}	dBm	$\frac{nV}{\sqrt{Hz}}$	dBm/Hz	dBFS/ Hz	
	Direct	1	4.0	18	–142	–146.0	
	Low Gain	0.06	–20.4	9	–148	–127.6	
	Low Gain	0.1	–16.0	9	–148	–132.0	
	Low Gain	0.4	–4.0	13	–145	–141.0	
	Low Gain	1	4.0	18	–142	–146.0	
	Low Gain	2	10.0	35	–136	–146.0	
	High Gain	4	16.0	71	–130	–146.0	
	High Gain	12	25.6	213	–120	–145.6	
Intermodulation Distortion (IMD)	Path						Each tone is –7 dBFS. All values are typical.
	Direct		Low-Gain Amplifier		High-Gain Amplifier		
10.2 MHz and 11.2 MHz	–81 dBc		–80 dBc		–62 dBc		
10.6 MHz and 10.8 MHz	–81 dBc		–79 dBc		–61 dBc		
19.5 MHz and 20.5 MHz	–78 dBc		–66 dBc		–54 dBc		
19.9 MHz and 20.1 MHz	–78 dBc		–65 dBc		–50 dBc		
34.0MHz and 35.0 MHz	–75 dBc		–58 dBc		–51 dBc		
34.8 MHz and 35.0 MHz	–75 dBc		–58 dBc		–51 dBc		
42.0 MHz and 43.0 MHz	–75 dBc		–55 dBc		–51 dBc		
42.8 MHz and 43.0 MHz	–75 dBc		–55 dBc		–50 dBc		

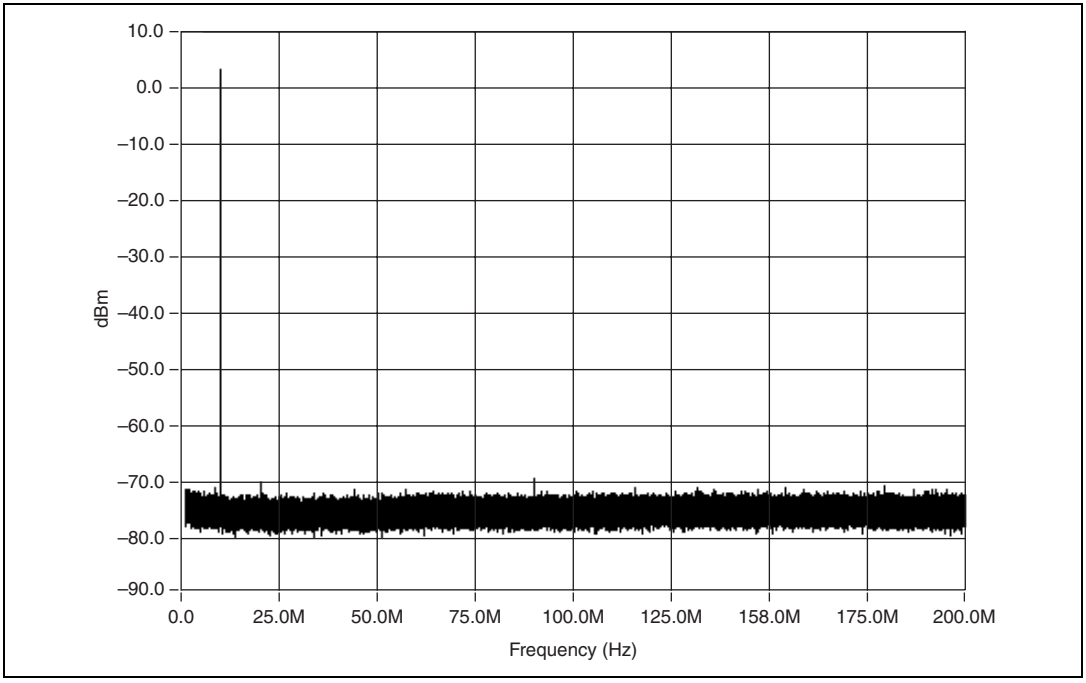

Figure 3. 10 MHz Single-Tone Spectrum, Direct Path, 100 MS/s, Interpolation Factor Set to 4

Note The noise floor in Figure 3 is limited by the measurement device. Refer to the *Average Noise Density* specification.

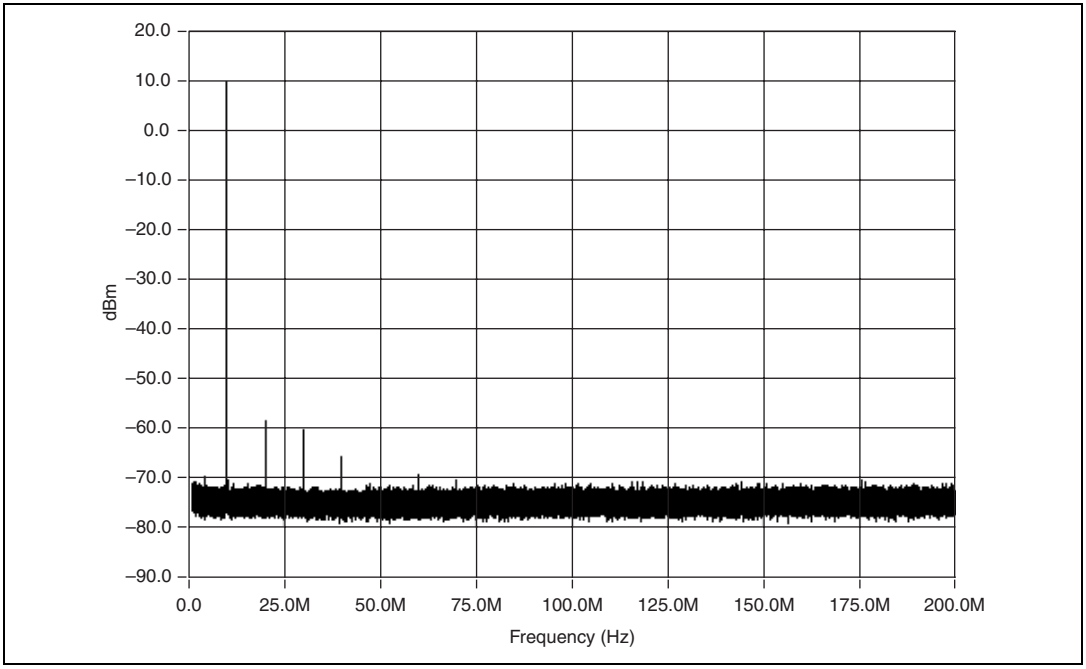

Figure 4. 10 MHz Single-Tone Spectrum, Low-Gain Amplifier Path, 100 MS/s, Interpolation Factor Set to 4

Note The noise floor in Figure 4 is limited by the measurement device. Refer to the *Average Noise Density* specification.

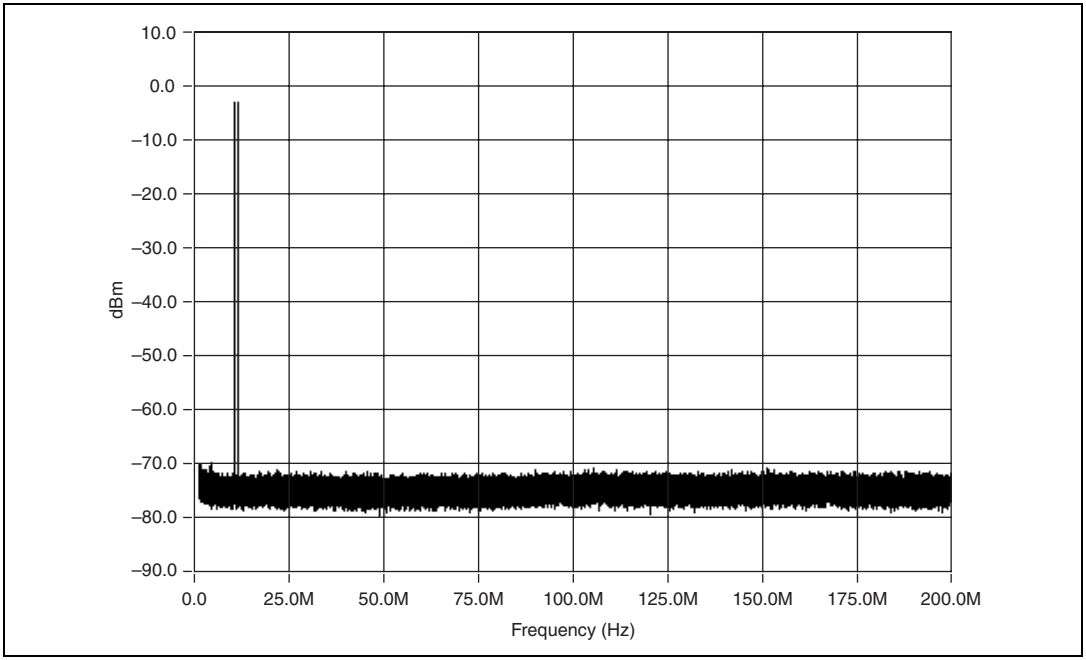

Figure 5. Direct Path, 2-Tone Spectrum (Typical)

Note The noise floor in Figure 5 is limited by the measurement device. Refer to the *Average Noise Density* specification.

Sample Clock

Table 2.

Specification	Value		Comments
Sources	1. Internal, Divide-by-*N* ($N \geq 1$) 2. Internal, DDS-based, High-Resolution 3. External, CLK IN (SMB front panel connector) 4. External, DDC CLK IN (DIGITAL DATA & CONTROL front panel connector) 5. **NI PXI-5421**: External, PXI Star trigger (backplane connector) 6. **NI PXI-5421**: External, PXI_Trig<0..7> (backplane connector) **NI PCI-5421**: External, RTSI<0..7>		Refer to the *Onboard Clock* section for more information about Internal Clock Sources.
Sample Rate Range and Resolution			
Sample Clock Source	Sample Rate Range	Sample Rate Resolution	—
Divide-by-*N*	23.84 S/s to 100 MS/s	Settable to (100 MS/s) / *N* ($1 \leq N \leq 4{,}194{,}304$)	
High Resolution	10 S/s to 100 MS/s	1.06 µHz	
CLK IN	200 kS/s to 105 MS/s	Resolution determined by external clock source. External Sample Clock duty cycle tolerance 40% to 60%.	
DDC CLK IN	10 S/s to 105 MS/s		
NI PXI-5421 PXI Star Trigger	10 S/s to 105 MS/s		
NI PXI-5421 PXI_Trig<0..7>	10 S/s to 20 MS/s		
NI PCI-5421 RTSI<0..7>	10 S/s to 20 MS/s		

Table 2. (Continued)

Specification	Value			Comments
Effective Sample Rate				
	Sample Rate (MS/s)	Interpolation Factor	Effective Sample Rate	Effective Sample Rate = (Interpolation Factor) * (Sample Rate)
	10 S/s to 105 MS/s	1 (Off)	10 S/s to 105 MS/s	
	12.5 MS/s to 105 MS/s	2	25 MS/s to 210 MS/s	
	10 MS/s to 100 MS/s	4	40 MS/s to 400 MS/s	
	10 MS/s to 50 MS/s	8	80 MS/s to 400 MS/s	
Sample Clock Delay Range and Resolution				
Sample Clock Source	Delay Adjustment Range		Delay Adjustment Resolution	—
Divide-by-*N*	±1 sample clock period		<10 ps	
High-Resolution	±1 sample clock period		Sample Clock Period/16,384	
External (all)	0 ns to 7.6 ns		<15 ps	

Table 2. (Continued)

Specification	Value				Comments
System Phase Noise and Jitter (10 MHz Carrier)					
Sample Clock Source	System Phase Noise Density (dBc/Hz) Offset			System Output Jitter (Integrated from 100 Hz to 100 kHz)	1. High-Resolution specifications increase as the Sample Rate is decreased. 2. **NI PXI-5421** PXI Star trigger specification is valid when the Sample Clock Source is locked to PXI_CLK10.
	100 Hz	1 kHz	10 kHz		
NI PXI-5421 Divide-by-*N*	–107	–121	–137	<1.2 ps rms	
NI PCI-5421 Divide-by-*N*	–110	–127	–137	<2.0 ps rms	
High-Resolution[1]	–109	–121	–123	<4.2 ps rms	
NI PXI-5421 CLK IN	–111	–122	–135	<1.2 ps rms	
NI PCI-5421 CLK IN	–113	–125	–135	<2.0 ps rms	
NI PXI-5421 PXI Star Trigger[2]	–115	–118	–130	<3.0 ps rms	
External Sample Clock Input Jitter Tolerance	Cycle-Cycle Jitter ±300 ps Period Jitter ±1 ns				—

Table 2. (Continued)

Specification	Value			Comments
Sample Clock Exporting				
Exported Sample Clock Destinations	1. PFI<0..1> (SMB front panel connectors) 2. DDC CLK OUT (DIGITAL DATA & CONTROL front panel connector) 3. **NI PXI-5421**—PXI_Trig<0..7> (backplane connector) **NI PCI-5421**—RTSI<0..7>			Exported Sample Clocks can be divided by integer K ($1 \le K \le$ 4,194,304).
Exported Sample Clock Destinations	Maximum Frequency	Jitter (Typical)	Duty Cycle	—
PFI<0..1>	105 MHz	PFI 0: 6 ps rms PFI 1: 12 ps rms	25% to 65%	
DDC CLK OUT	105 MHz	40 ps rms	40% to 60%	
NI PXI-5421 PXI_Trig<0..7>	20 MHz	—	—	
NI PCI-5421 RTSI<0..7>	20 MHz	—	—	

Onboard Clock
(Internal VCXO)

Table 3.

Specification	Value	Comments
Clock Source	Internal sample clocks can either be locked to a Reference Clock using a phase-locked loop or be derived from the onboard VCXO frequency reference.	—
Frequency Accuracy	±25 ppm	—

Phase-Locked Loop (PLL) Reference Clock

Table 4.

Specification	Value	Comments
Sources	1. **NI PXI-5421**—PXI_CLK10 (backplane connector) **NI PCI-5421**—RTSI_7 (RTSI_CLK) 2. CLK IN (SMB front panel connector)	The PLL Reference Clock provides the reference frequency for the phase-locked loop.
Frequency Accuracy	When using the PLL, the Frequency Accuracy of the NI 5421 is solely dependent on the Frequency Accuracy of the PLL Reference Clock Source.	—
Lock Time	Typical: 70 ms. Maximum: 200 ms.	—
Frequency Range	5 MHz to 20 MHz in increments of 1 MHz. Default of 10 MHz. The PLL Reference Clock Frequency has to be accurate to ±50 ppm.	—
Duty Cycle Range	40% to 60%	—
Exported PLL Reference Clock Destinations	1. PFI<0..1> (SMB front panel connectors) 2. **NI PXI-5421**—PXI_Trig<0..7> (backplane connector) **NI PCI-5421**—RTSI<0..7>	—

CLK IN
(Sample Clock and Reference Clock Input, Front Panel Connector)

Table 5.

Specification	Value	Comments
Connector	SMB (jack)	—
Direction	Input	—
Destinations	1. Sample Clock 2. PLL Reference Clock	—
Frequency Range	1 MHz to 105 MHz (Sample Clock destination and sine waves) 200 kHz to 105 MHz (Sample Clock destination and square waves) 5 MHz to 20 MHz (PLL Reference Clock destination)	—
Input Voltage Range	Sine wave: 0.65 V_{pk-pk} to 2.8 V_{pk-pk} into 50 Ω (0 dBm to +13 dBm) Square wave: 0.2 V_{pk-pk} to 2.8 V_{pk-pk} into 50 Ω	—
Maximum Input Overload	±10 V	—
Input Impedance	50 Ω	—
Input Coupling	AC	—

PFI 0 and PFI 1
(Programmable Function Interface, Front Panel Connectors)

Table 6.

Specification	Value	Comments
Connectors	Two SMB (jack)	—
Direction	Bi-directional	—
Frequency Range	DC to 105 MHz	—
As an Input (Trigger)		
Destinations	Start Trigger	—
Maximum Input Overload	–2 V to +7 V	—
V_{IH}	2.0 V	
V_{IL}	0.8 V	
Input Impedance	1 kΩ	
As an Output (Event)		
Sources	1. Sample Clock divided by integer K ($1 \le K \le 4{,}194{,}304$) 2. Sample Clock Timebase (100 MHz) divided by integer M ($2 \le M \le 4{,}194{,}304$) 3. PLL Reference Clock 4. Marker 5. Exported Start Trigger (Out Start Trigger)	—
Output Impedance	50 Ω	—
Maximum Output Overload	–2 V to +7 V	—

Table 6. (Continued)

Specification	Value	Comments
V_{OH}	Minimum: 2.9 V (open load), 1.4 V (50 Ω load)	Output drivers are +3.3 V TTL compatible. Measured with a 1 m cable.
V_{OL}	Maximum: 0.2 V (open load), 0.2 V (50 Ω load)	
Rise/Fall Time (20% to 80%)	≤2.0 ns	Load of 10 pF.

Table 7.

Specification	Value			Comments
Connector Type	68-pin VHDCI female receptacle			—
Number of Data Output Signals	16			—
Control Signals	1. DDC CLK OUT (clock output) 2. DDC CLK IN (clock input) 3. PFI 2 (input) 4. PFI 3 (input) 5. PFI 4 (output) 6. PFI 5 (output)			—
Ground	23 pins			—
Output Signal Characteristics (Includes Data Outputs, DDC CLK OUT, and PFI<4..5>)				
Signal Type	LVDS (Low-Voltage Differential Signal)			—
Signal Characteristics	Minimum	Typical	Maximum	1. Tested with 100 Ω differential load. 2. Measured at the front panel. 3. Load capacitance <10 pF. 4. Driver and receiver comply with ANSI/TIA/EIA-644. 5. Rise time is 20% to 80%.
V_{OH}	—	1.3 V	1.7 V	
V_{OL}	0.8 V	1.0 V	—	
Differential Output Voltage	0.25 V	—	0.45 V	
Output Common-Mode Voltage	1.125 V	—	1.375 V	
Rise/Fall Time	—	0.8 ns	1.6 ns	

Table 7. (Continued)

Specification	Value		Comments
Output Signal Characteristics (Continued)			
Output Skew	Typical: 1 ns, maximum 2 ns. Skew between any two outputs on the DIGITAL DATA & CONTROL front panel connector.		—
Output Enable/Disable	Controlled through the software on all Data Output Signals and Control Signals collectively. When disabled, the outputs go to a high-impedance state.		—
Maximum Output Overload	–0.3 V to +3.9 V		—
Input Signal Characteristics (Includes DDC CLK IN and PFI<2..3>)			
Signal Type	LVDS (Low-Voltage Differential Signal)		—
Input Differential Impedance	100 Ω		—
Maximum Output Overload	–0.3 V to +3.9 V		—
Signal Characteristics	Minimum	Maximum	—
Differential Input Voltage	0.1 V	0.5 V	
Input Common Mode Voltage	0.2 V	2.2 V	
DDC CLK OUT			
Clocking Format	Data outputs and markers change on the falling edge of DDC CLK OUT.		—
Frequency Range	Refer to the *Sample Clock* section for more information.		—
Duty Cycle	40% to 60%		—
Jitter	40 ps rms		—

Table 7. (Continued)

Specification	Value	Comments
DDC CLK IN		
Clocking Format	DDC Data Output signals change on the rising edge of DDC CLK IN.	—
Frequency Range	10 Hz to 105 MHz	—
Input Duty Cycle Tolerance	40% to 60%	—
Input Jitter Tolerances	300 ps pk-pk of Cycle-Cycle Jitter, and 1 ns rms of Period Jitter.	—

Start Trigger

Table 8.

Specification	Value	Comments
Sources	1. PFI<0..1> (SMB front panel connectors) 2. PFI<2..3> (DIGITAL DATA & CONTROL front panel connector) 3. **NI PXI-5421**—PXI_Trig<0..7> (backplane connector) **NI PCI-5421**—RTSI<0..7> 4. **NI PXI-5421**—PXI Star trigger (backplane connector) 5. Software (use function call) 6. Immediate (does not wait for a trigger). Default.	—
Modes	1. Single 2. Continuous 3. Stepped 4. Burst	—
Edge Detection	Rising	—
Minimum Pulse Width	25 ns. Refer to t_{s1} at **NI Signal Generators Help»Devices» NI 5421»NI <bus>-5421»Triggering»Trigger Timing**.	—

Table 8. (Continued)

Specification	Value		Comments
Delay from Start Trigger to CH 0 Analog Output	Interpolation Factor	Typical Delay	Refer to t_{s2} at **NI Signal Generators Help»Devices» NI 5421» NI <bus>-5421» Triggering» Trigger Timing**.
	Digital Interpolation Filter disabled.	43 Sample Clock Periods + 110 ns	
	2	57 Sample Clock Periods + 110 ns	
	4	63 Sample Clock Periods + 110 ns	
	8	64 Sample Clock Periods + 110 ns	
Delay from Start Trigger to Digital Data Output	40 Sample Clock periods + 110 ns.		—
Trigger Exporting			
Exported Trigger Destinations	A signal used as a trigger can be routed out to any destination listed in the *Destinations* specification of Table 9.		—
Exported Trigger Delay	65 ns (typical). Refer to t_{s3} at **NI Signal Generators Help» Devices»NI 5421»NI <bus>-5421»Triggering»Trigger Timing**.		—
Exported Trigger Pulse Width	>150 ns. Refer to t_{s4} at **NI Signal Generators Help» Devices»NI 5421»NI <bus>-5421»Triggering»Trigger Timing**.		—

Table 9.

<table>
<tr><th>Specification</th><th colspan="3">Value</th><th>Comments</th></tr>
<tr><td>Destinations</td><td colspan="3">1. PFI<0..1> (SMB front panel connectors)
2. PFI<4..5> (DIGITAL DATA & CONTROL front panel connector)
3. NI PXI-5421—PXI_Trig<0..6> (backplane connector)
NI PCI-5421—RTSI<0..7></td><td>—</td></tr>
<tr><td>Quantity</td><td colspan="3">One Marker per Segment.</td><td>—</td></tr>
<tr><td>Quantum</td><td colspan="3">Marker position must be placed at an integer multiple of four samples.</td><td>—</td></tr>
<tr><td>Width</td><td colspan="3">>150 ns. Refer to t_{m2} at NI Signal Generators Help» Devices»NI 5421»NI <bus>-5421»Waveform Generation»Marker Events.</td><td>—</td></tr>
<tr><td rowspan="4">Skew</td><td>Destination</td><td>With Respect to Analog Output</td><td>With Respect to Digital Data Output</td><td rowspan="4">Refer to t_{m1} at NI Signal Generators Help»Devices» NI 5421» NI <bus>-5421» Waveform Generation» Marker Events.</td></tr>
<tr><td>PFI<0..1></td><td>±2 Sample Clock Periods</td><td>N/A</td></tr>
<tr><td>PFI<4..5></td><td>N/A</td><td><2 ns</td></tr>
<tr><td>NI PXI-5421
PXI_Trig<0..6>
NI PCI-5421
RTSI<0..6></td><td>±2 Sample Clock Periods</td><td>N/A</td></tr>
<tr><td>Jitter</td><td colspan="3">20 ps rms</td><td>—</td></tr>
</table>

Waveform and Instruction Memory Utilization

Table 10.

Specification	Value			Comments
Memory Usage	The NI 5421 uses the Synchronization and Memory Core (SMC) technology in which waveforms and instructions share onboard memory. Parameters, such as number of segments in sequence list, maximum number of waveforms in memory, and number of samples available for waveform storage, are flexible and user defined.			For more information, refer to **NI Signal Generators Help» Programming» NI-TClk Synchronization Help**.
Onboard Memory Size	8 MB standard: 8,388,608 bytes	32 MB option: 33,554,432 bytes	256 MB option: 268,435,456 bytes	—
Output Modes	Arbitrary Waveform mode and Arbitrary Sequence mode			—
Arbitrary Waveform Mode	In Arbitrary Waveform mode, a single waveform is selected from the set of waveforms stored in onboard memory and generated.			—
Arbitrary Sequence Mode	In Arbitrary Sequence mode, a sequence directs the NI 5421 to generate a set of waveforms in a specific order. Elements of the sequence are referred to as segments. Each segment is associated with a set of instructions. The instructions identify which waveform is selected from the set of waveforms in memory, how many loops (iterations) of the waveform are generated, and at which sample in the waveform a marker output signal is sent.			—
Minimum Waveform Size (Samples)	Trigger Mode	Arbitrary Waveform Mode	Arbitrary Sequence Mode	The Minimum Waveform Size is sample rate dependent in Arbitrary Sequence Mode.
	Single	16	16	
	Continuous	16	96 @ >50 MS/s	
			32 @ ≤50 MS/s	
	Stepped	32	96 @ >50 MS/s	
			32 @ ≤50 MS/s	
	Burst	16	512 @ >50 MS/s	
			256 @ ≤50 MS/s	

Table 10. (Continued)

Specification	Value			Comments
Loop Count	1 to 16,777,215. Burst trigger: Unlimited			—
Quantum	Waveform size must be an integer multiple of four samples.			—
Memory Limits				
	8 MB Standard	32 MB Option	256 MB Option	All trigger modes except where noted.
Arbitrary Waveform Mode, Maximum Waveform Memory	4,194,176 Samples	16,777,088 Samples	134,217,600 Samples	
Arbitrary Sequence Mode, Maximum Waveform Memory	4,194,120 Samples	16,777,008 Samples	134,217,520 Samples	Condition: One or two segments in a sequence.
Arbitrary Sequence Mode, Maximum Waveforms	65,000 Burst trigger: 8,000	262,000 Burst trigger: 32,000	2,097,000 Burst trigger: 262,000	Condition: One or two segments in a sequence.
Arbitrary Sequence Mode, Maximum Segments in a Sequence	104,000 Burst trigger: 65,000	418,000 Burst trigger: 262,000	3,354,000 Burst trigger: 2,090,000	Condition: Waveform memory is <4,000 samples.

Calibration

Table 11.

Specification	Value	Comments
Self-Calibration	An onboard, 24-bit ADC and precision voltage reference are used to calibrate the DC gain and offset. The self-calibration is initiated by the user through the software and takes approximately 75 seconds to complete.	—
External Calibration	The External Calibration calibrates the VCXO, voltage reference, DC gain, and offset. Appropriate constants are stored in nonvolatile memory.	—
Calibration Interval	Specifications valid within 2 years of External Calibration.	—
Warm-up Time	15 minutes	—

Power

Table 12.

Specification	Typical Operation	Overload Operation	Comments
+3.3 VDC	1.9 A	2.7 A	Typical. Overload operation occurs when CH 0 is shorted to ground.
+5 VDC	2.0 A	2.2 A	
+12 VDC	0.46 A	0.5 A	
–12 VDC	0.01 A	0.01 A	
Total Power	21.9 W	26.0 W	

Table 13.

Specification	Value	Comments
Driver Software	NI-FGEN 2.0 or later version. NI-FGEN is an IVI-compliant driver that allows you to configure, control, and calibrate the NI 5421. NI-FGEN provides application programming interfaces for many development environments.	—
Application Software	NI-FGEN provides programming interfaces for the following application development environments: • LabVIEW • LabWindows™/CVI™ • Measurement Studio • Microsoft Visual C/C++ • Microsoft Visual Basic • Borland C/C++	—
Soft Front Panel/ Interactive Configuration	The FGEN Soft Front Panel 1.3 or later supports interactive control of the NI 5421. The FGEN Soft Front Panel is included on the NI-FGEN driver CD. Measurement & Automation Explorer (MAX) also provides interactive configuration and test tools for the NI 5421. MAX is also included on the NI-FGEN CD.	—

Environment

NI PXI-5421 Environment

Note To ensure that the NI PXI-5421 cools effectively, follow the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the NI 5421 kit. The NI PXI-5421 is intended for indoor use only.

Table 14.

Specifications	Value	Comments
Operating Temperature	0 ºC to +55 ºC in all NI PXI chassis except the following: 0 ºC to +45 ºC when installed in an NI PXI-101*x* or NI PXI-1000B chassis. Meets IEC-60068-2-1 and IEC-60068-2-2.	—
Storage Temperature	–25 ºC to +85 ºC. Meets IEC-60068-2-1 and IEC-60068-2-2.	—
Operating Relative Humidity	10% to 90%, noncondensing. Meets IEC-60068-2-56.	—
Storage Relative Humidity	5% to 95%, noncondensing. Meets IEC-60068-2-56.	—
Operating Shock	30 g, half-sine, 11 ms pulse. Meets IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.	Spectral and jitter specifications could degrade.
Storage Shock	50 g, half-sine, 11 ms pulse. Meets IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.	—
Operating Vibration	5 Hz to 500 Hz, 0.31 g_{rms}. Meets IEC-60068-2-64.	Spectral and jitter specifications could degrade.
Storage Vibration	5 Hz to 500 Hz, 2.46 g_{rms}. Meets IEC-60068-2-64. Test profile exceeds requirements of MIL-PRF-28800F, Class B.	—
Altitude	2,000 m maximum (at 25 °C ambient temperature)	—
Pollution Degree	2	—

NI PCI-5421 Environment

Note To ensure that the NI PCI-5421 cools effectively, follow the guidelines in the *Maintain Forced-Air Cooling Note to Users* included in the NI 5421 kit. Also, to maximize airflow and extend the life of the device, leave any adjacent PCI slots empty. The NI PCI-5421 is intended for indoor use only.

Table 15.

Specifications	Value	Comments
Operating Temperature	0 ºC to +45 ºC. Meets IEC-60068-2-1 and IEC-60068-2-2.	—
Storage Temperature	–25 ºC to +85 ºC. Meets IEC-60068-2-1 and IEC-60068-2-2.	—
Operating Relative Humidity	10% to 90%, noncondensing. Meets IEC-60068-2-56.	—
Storage Relative Humidity	5% to 95%, noncondensing. Meets IEC-60068-2-56.	—
Storage Shock	50 g, half-sine, 11 ms pulse. Meets IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.	—
Storage Vibration	5 Hz to 500 Hz, 2.46 g_{rms}. Meets IEC-60068-2-64. Test profile exceeds requirements of MIL-PRF-28800F, Class B.	—
Altitude	2,000 m maximum (at 25 °C ambient temperature)	—
Pollution Degree	2	—

Safety, Electromagnetic Compatibility, and CE Compliance

Table 16.

Specification	Value	Comments
Safety	The NI 5421 is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use: IEC 61010-1, EN 61010-1 UL 61010-1 CAN/CSA-C22.2 No. 61010-1	—
Note: For UL and other safety certifications, refer to the product label or visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.		
Emissions	EN 55011 Class A at 10 m FCC Part 15A above 1 GHz	—
Immunity	EN 61326:1997 + A2:2001, Table 1	—
EMC/EMI	CE, C-Tick, and FCC Part 15 (Class A) Compliant **Notes**: 1. This device is not intended for, and is restricted from, use in residential areas. 2. For EMC compliance, operate this device with shielded cabling. 3. When connected to other test objects, this product may cause radio interference. If this occurs, you may be required to take adequate measures to reduce the interference.	—
This product meets the essential requirements of applicable European Directives as amended for CE marking, as follows:		
Low-Voltage Directive (safety)	73/23/EEC	—
Electromagnetic Compatibility Directive (EMC)	89/336/EEC	—
Note: Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.		

Physical

Table 17.

Specification	Value		Comments
Dimensions	NI PXI-5421	NI PCI-5421	—
	3U, One Slot, PXI/cPCI Module 2.0 × 13.0 × 21.6 cm (0.8 × 5.1 × 8.5 inches)	34.07 × 10.67 × 2.03 cm (13.4 × 4.20 × 0.8 inches)	
Weight	345 g (12.1 oz)	419 g (14.8 oz)	—
Front Panel Connectors			
Label	Function(s)	Connector Type	—
CH 0	Analog Output	SMB (jack)	
CLK IN	Sample clock input and PLL reference clock input.	SMB (jack)	
PFI 0	Marker output, trigger input, sample clock output, exported trigger output, and PLL reference clock output.	SMB (jack)	
PFI 1	Marker output, trigger input, sample clock output, exported trigger output, and PLL reference clock output.	SMB (jack)	
DIGITAL DATA & CONTROL	Digital data output, trigger input, exported trigger output, markers, external sample clock input, and sample clock output.	68-pin VHDCI female receptacle	

Table 17. (Continued)

Specification	Value	Comments
NI PXI-5421 Only—Front Panel LED Indicators		
Label	Function	For more information, refer to the *NI Signal Generators Help*.
ACCESS LED	The ACCESS LED indicates the status of the PCI bus and the interface from the NI 5421 to the controller.	
ACTIVE LED	The ACTIVE LED indicates the status of the onboard generation hardware of the NI 5421.	
Included Cable		
	1 (NI part number 763541-01), 50 Ω, BNC Male to SMB Plug, RG223/U, Double Shielded, 1 m cable.	—

Where to Go for Support

The National Instruments Web site is your complete resource for technical support. At `ni.com/support` you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

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